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DESCRIPTION

ENCODING APPARATUS AND METHOD,

RECORDING APPARATUS AND METHOD, AND

5   DECODING APPARATUS AND METHOD

TECHNICAL FIELD

[0001]

The present invention relates to an encoding

10   apparatus and a method for encoding and compressing an

image signal by in-frame encoding and inter-frame

prediction encoding. The invention also relates to a

recording apparatus and a method for recording an image

signal to a recording medium, and further, the invention

15   relates to a decoding apparatus and a method for

decoding the image signal encoded and compressed by in-

frame encoding and inter-frame prediction encoding.

BACKGROUND ART

20   [0002]

As a method for compressing and encoding to reduce

a coding amount of an image signal, an MPEG2 method is

widely known. As the image data encoded and compressed

by the MPEG2 method, there are three types: I picture

25   encoded by in-frame encoding, and P picture and B

picture encoded by inter-frame prediction encoding. A group of continuous pictures including at least one I picture is called GOP (Group Of Pictures).

An image data encoded by an MPEG encoder must be

5 transferred to an MPEG decoder as an MPEG2-transport stream (hereinafter referred as "MPEG2-TS"). The MPEG decoder must decode the MPEG2-TS by synchronizing it with the MPEG encoder. In this respect, the MPEG encoder adds PCR (Program Clock Reference) to the MPEG2-TS as

10 time stamp information (time information) and transfers it. The MPEG decoder decodes the image data and outputs an image signal decoded at display timing based on PCR.

Patent Document 1: Japanese Patent Application Publication 2003-230092

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DISCLOSURE OF THE INVENTION

[0003]

Problems to be solved by the Invention

As a recording apparatus (so-called video camera)

20 for recording an image signal taken by a camera on a magnetic tape, a digital video camera is known, which uses a tape cassette of DV type and an image signal is recorded on the magnetic tape of the tape cassette by MPEG2 method.

25 In a video camera of this type, when a user

performs jointed image-taking (stop-and-resume image-
taking), PCR becomes discontinuous before and after the
jointed image-taking when the image data is reproduced
from the magnetic tape and the image data is encoded. As
5   a result, the image signal decoded by the decoder cannot
be displayed at correct display timing, and the freezing
of image occurs. This problem is also described in the
Patent Document 1.

[0004]

10 To solve the above problem, it is an object of the
present invention to provide an encoding apparatus and
an encoding method, a recording apparatus and a
recording method, and a decoding apparatus and a
decoding method, in which no freezing of image occurs
15 even when time information becomes discontinuous as in
the case of jointed image-taking, and by which it is
possible to display the image signal before and after
the jointed image-taking without trouble.

20 Means for solving the Problem

[0005]

To solve the technical problems in the past as
described above, the present invention provides an
encoding apparatus for generating a transport stream by
25 encoding an image signal, characterized by an image

encoding unit for encoding said image signal by in-frame encoding and by inter-frame prediction encoding and for generating an image encoding data sorted in groups to GOP comprising a plurality of pictures, a time

5   information generating unit for generating time information multiplexed in said transport stream, an identification information generating unit for generating identification information to indicate that continuity of time information is interrupted when the

10   continuity of said time information multiplexed in said transport stream has been interrupted, and a multiplexing unit for multiplexing said image encoding data with said time information and said identification information and for outputting it as a transport stream.

15   Here, it is preferable that the multiplexing unit multiplexes said identification information on a part of bits of a private data, which is an adaptation field in a transport packet to make up said transport stream and which constitutes an optional field in said adaptation

20   field.

     Also, it is preferable that said multiplexing unit outputs a packet, which includes said identification information within a predetermined time period from the time when a packet including the leading byte of GOP has

25   been outputted. Also, it is preferable that said

predetermined time period is 3 milliseconds.

[0006]

To solve the technical problems in the past as described above, the present invention provides an encoding method for generating a transport stream by encoding an image signal, characterized by encoding said image signal by in-frame encoding and by inter-frame prediction encoding, and generating an image encoding data sorted in groups to GOP comprising a plurality of pictures; generating time information multiplexed in said transport stream; generating identification information to indicate that continuity of time information is interrupted when continuity of said time information multiplexed in said transport stream has been interrupted; and multiplexing said image encoding data with said time information and said identification information, and outputting it as the transport stream.

Here, it is preferable that said identification information is multiplexed on a part of bits of a private data, which is an adaptation field in a transport packet to make up said transport stream and which constitutes an optional field in said adaptation field.

Also, it is preferable that a packet including said identification information within a predetermined time

period from the time when a packet including the leading byte of GOP has been outputted. It is also preferable that said predetermined time period is 3 milliseconds.

[0007]

5   Further, to solve the technical problems in the past as described above, the present invention provides a recording apparatus for recording an image signal to a recording medium, characterized by an image encoding unit for encoding said image signal by in-frame encoding

10   and by inter-frame prediction encoding, and for generating an image encoding data sorted in groups to GOP comprising a plurality of pictures; a time information generating unit for generating time information to be recorded in said recording medium; an

15   identification information generating unit for generating identification information to indicate that continuity of time information is interrupted when the continuity of the time information to be recorded in said recording medium has been interrupted; a

20   multiplexing unit for multiplexing said image encoding data with said time information and said identification information and for outputting it as a transport stream; and a recording unit for sequentially recording said transport stream as tracks on said recording medium.

25   Here, it is preferable that the multiplexing unit

multiplexes said identification information on a part of bits of a private data, which is an adaptation field in a transport packet to make up said transport stream and which constitutes an optional field in said adaptation

5 field.

Also, it is preferable that said multiplexing unit outputs a packet, which includes said identification information within a predetermined time period from the time when a packet including the leading byte of GOP has

10 been outputted. Also, it is preferable that said predetermined time period is 3 milliseconds.

[0008]

Also, to solve the technical problems in the past as described above, the present invention provides a

15 recording method for recording an image signal to a recording medium, characterized by encoding said image signal by in-frame encoding and by inter-frame prediction encoding and generating an image encoding data sorted in groups to GOP comprising a plurality of

20 pictures, generating time information to be recorded in said recording medium, generating identification information to indicate that continuity of time information is interrupted when continuity of the time information to be recorded in said recording medium has

25 been interrupted, multiplexing said image encoding data

with said time information and said identification information and outputting as a transport stream, and sequentially recording said transport stream as tracks on said recording medium.

5   Here, it is preferable that said identification information is multiplexed on a part of bits of a private data, which is an adaptation field in a transport packet to make up said transport stream and which constitutes an optional field in said adaptation

10   field.

Also, it is preferable that a packet including said identification information within a predetermined time period from the time when a packet including the leading byte of GOP has been outputted. It is also preferable

15   that said predetermined time period is 3 milliseconds.

[0009]

Further, to solve the technical problems in the past as described above, the present invention provides a decoding apparatus for decoding a transport stream

20   multiplexed with an image encoding data, time information and identification information, said image encoding data being prepared by encoding an image signal by in-frame encoding and by inter-frame prediction encoding, and said identification information indicates

25   that continuity of time information is interrupted when

continuity of said time information has been interrupted, characterized by an image decoding unit for decoding said image decoding data and for outputting said image data, a storage unit for temporarily storing said image

5   data, a time information reading unit for reading said time information; an identification information reading unit for reading said identification information, a display timing signal generating unit for generating a display timing signal of said image data by using said

10   time information read by said time information reading unit when said identification information reading unit does not read said identification information, and for neglecting said time information read by said time information reading unit and for generating a display

15   timing signal of said image data by using a predetermined timing signal, and a reading control unit for controlling the reading of said image data stored in said storage unit according to a display timing signal generated by said display timing signal generating unit.

20   Also, to solve the technical problems in the past as described above, the present invention provides a decoding method for decoding a transport stream multiplexed with an image encoding data, time information and identification information, said image

25   encoding data being prepared by encoding an image signal

by in-frame encoding and by inter-frame prediction encoding, and said identification information indicates that continuity of time information is interrupted when continuity of said time information has been interrupted,

5 characterized by decoding said image encoding data and outputting an image data, temporarily storing said image data, reading said time information and reading said identification information, generating a display timing of said image data by using said time information as

10 read when said identification information has not been read, and neglecting said time information as read and generating a display timing signal of said image data by using a predetermined timing signal when said identification information has been read, and

15 controlling the reading of said image data as stored according to the generated display timing signal.

Advantageous Effects of the Invention

[0010]

20 According to the present invention, no freezing of image occurs even when the jointed image-taking is performed and the image signal can be displayed without trouble before and after the jointed image-taking.

25 BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

[Fig. 1] A block diagram showing an embodiment of an encoding apparatus, a recording apparatus and a decoding apparatus of the present invention.

[Fig. 2] A drawing explaining for jointed image-taking.

[Fig. 3] A drawing explaining for jointed image-taking.

[Fig. 4] A block diagram showing a detailed embodiment of an encoding apparatus of the present invention.

[Fig. 5] A drawing showing an MPEG2-transport stream.

[Fig. 6] A drawing showing an example of recording pattern on a magnetic tape when the jointed image-taking is performed.

[Fig. 7] A block diagram showing a detailed aspect of the decoding apparatus of the present invention.

[Fig. 8] A block diagram showing an example of a concrete arrangement of an IEEE1394 interface 112 shown in Fig. 1.

[Fig. 9] A drawing explaining transfer of AV data via the IEEE1394 interface 112.

BEST MODE FOR CARRYING OUT THE INVENTION

[0012]

Description will be given below on an encoding apparatus and an encoding method, a recording apparatus and a recording method, and a decoding apparatus and a decoding method according to the present invention. Fig. 1 is a block diagram to show an aspect of an encoding apparatus, a recording apparatus and a decoding apparatus of the present invention. Fig. 2 and Fig. 3 each represents a drawing to explain jointed image-taking. Fig. 4 is a block diagram to show a detailed embodiment of an encoding apparatus of the present invention. Fig. 5 represents a drawing and a table to show an MPEG2-transport stream. Fig. 6 is a drawing to show an example of recording pattern on a magnetic tape when the jointed image-taking is performed. Fig. 7 is a block diagram of a detailed aspect of the decoding apparatus of the present invention. Fig. 8 is a block diagram to show an example of a concrete arrangement of an IEEE1394 interface 112 shown in Fig. 1, and Fig. 9 is a drawing to explain transfer of AV data via the IEEE1394 interface 112.

[0013]

A recording apparatus 100 of an aspect of the invention shown in Fig. 1 complies with the provisions as set forth in the HD Digital VCR Conference, and it is

an example of a video camera, by which it can be selected whether to record and reproduce a standard (SD) signal such as NTSC signal by DV method, or to record and reproduce high definition (HD) signal by MPEG2 method. The HD signal is defined as a progressive signal (720P) including 720 valid scan lines or an interlace signal (1080i) including 1080 valid scan lines.

In Fig. 1, an image to be taken (an optical signal) coming through a lens (not shown) is converted to an image pickup signal (an electric signal) by an image pickup element 101 and is shaped to an image signal at a camera signal processing circuit 102. The image signal outputted from the camera signal processing circuit 102 and the image signal supplied from an external signal input terminal 131 are inputted to a switching device 120. The switching device 120 sends the image signal to a DV encoder 103 and an MPEG encoder 104. Naturally, the image signal may not be supplied from the external signal input terminal 131.

[0014]

The DV encoder 103 encodes the inputted image signal by DV encoding. The MPEG encoder 104 encodes the inputted image signal by MPEG2 encoding. A DV encoding data outputted from the DV encoder 103 and an MPEG 2 encoding data outputted from the MPEG encoder 104 are

inputted to a switching device 121.

An operation unit 110 is provided with a recording mode selecting button 1101 for selecting whether the image signal is to be recorded to a recording medium 107

5 (serving as a tape cassette of DV type) in DV format or it is to be recorded by MPEG2 method. A system control unit 111 controls the switching device 121 depending on the selection by the recording mode selecting button 1101, and the switching device 121 supplies either the

10 DV encoding data from the DV encoder 103 or the MPEG 2 encoding data from the MPEG encoder 104 to the recording signal processing circuit 105. Detailed description will be given later on concrete arrangement and operation of the MPEG encoder 104, which is an aspect of the encoding

15 apparatus of the present invention.

[0015]

The recording signal processing circuit 105 performs mapping on the DV encoding data or the MPEG encoding data, adds various types of identification data

20 and supplies it to a recording amplifier 106. The recording amplifier 106 amplifies the inputted data and supplies it to a mechanism driving unit 1071 including a recording head. In addition to a recording head and a reproducing head provided on a rotating drum, the

25 mechanism driving unit 1071 further comprises a loading

mechanism and a running mechanism. The loading mechanism

picks up a magnetic tape of the recording medium 107

from a tape cassette, and the running mechanism is to

run the magnetic tape. As a mechanism driving unit 1071,

5   a mechanism already known can be adopted, and detailed

description on the arrangement and on the operation is

not given here.

The DV encoding data or the MPEG2 encoding data

added with various types of identification data as

10 described above is recorded on the recording medium 107.

[0016]

Here, description will be given on the jointed

image-taking (stop-and-resume image-taking) referring to

Fig. 2 and Fig. 3. The jointed image-taking of the image

15 signal is to stop the recording on the recording medium

107 for once and to resume the recording. In the stop of

the recording, both the so-called record posing state

and complete stop of recording are included. When a user

presses a record starting button 1103 on the operation

20 unit 110 shown in Fig. 1, the recording apparatus 100

starts recording. On the recording medium 107, tracks

tilted with respect to the running direction of the

recording medium (magnetic tape) 107 are formed one

after another as shown in Fig. 2. If the user presses a

25 temporary recording stop button 1104 on the operation

unit 110 at a time t1, the recording is actually stopped

for once at a time t2. Here, it is supposed that

recording from the pressing of the temporary recording

stop button 1104 to the stop of the recording at the

5   time t2 is Rc1 as shown in Fig. 3. Then, the interval

between the time t1 and the time t2 is about 1 second.

When the user presses the recording start button

1103 again, the recording medium 107 is unwound for a

time interval of about 2 seconds. As shown by a broken

10 line in Fig. 3, reproducing operation is performed up to

the position of the track near the time t1 when

instruction is given to stop the recording in the

recording Rc1, and a new recording Rc2 is started from

the track position near the time t1. In the case of the

15 recording of the MPEG encoding data, the new recording

Rc2 is started from the leading head of GOP at the track

near the time t1. The time t1, at which an instruction

to stop the recording has been given, is stored in a

system control unit 111, and the jointed image-taking as

20 described above is carried out by using the time t1. As

shown by hatching in Fig. 2, the recording Rc1 as

recorded for once is erased by an erasing head for about

1 second between the time t1 and the time t2, and the

recording Rc2 is overwritten.

25   [0017]

As described above, the MPEG2 transport stream
(MPEG2-TS) comprising the MPEG2 encoding data contains
PCR, which is time information. PCR is continuous during
the time period of the recording Rc1, while PCR becomes

5   discontinuous when the recording is shifted from Rc1 to
Rc2. This discontinuation of PCR causes trouble in
decoding (reproducing) operation as described later, and
the freezing of image occurs.

This problem occurs - not only when the recording

10 is stopped and then it is resumed after the recording
has been started by the user as described above - but
also when the image is recorded newly at the middle of
the recording medium 107 where data has been already
recorded.

15   [0018]

Next, description will be given on an arrangement
of the MPEG encoder 104 shown in Fig. 1 referring to Fig.
4. In Fig. 4, processing of an audio (voice) signal is
also shown, which is not given in Fig. 1. In Fig. 4, an

20 image signal is encoded to an I picture compressed
within a frame and a P picture and a B picture
compressed between frames by an image encoding unit 1041.
The image encoding unit 1041 outputs an image encoding
data sorted in groups to GOP, which comprises a

25 plurality of pictures. The audio signal is encoded by an

audio encoding unit 1042. An STC counter 1043 is a counter driven by STC (System Time Clock).

A packetizing unit 1044 packetizes the image encoding data outputted from the image encoding unit 1041 and supplies it to a multiplexing unit 1047. The packetizing unit 1044 is provided with a PTS generating unit 10441, and the PTS generating unit 10441 generates PTS (Presentation Time Stamp). The encoding data outputted from the image encoding unit 1041 belongs to ES type, and output of the packetizing unit 1044 belongs to PES type. The packetizing unit 1045 packetizes the audio encoding data outputted from the audio encoding unit 1042 and supplies it to the multiplexing unit 1047.

[0019]

An information encoding unit 1046 comprises a PCR generating unit 10461 and a jointed image-taking information generating unit 10462. The PCR generating unit 10461 generates PCR. The jointed image-taking information generating unit 10462 generates a jointed image-taking information packet in response to a control signal, which indicates an instruction for jointed image-taking from the system control unit 111. In addition to the PCR and the jointed image-taking information packet, the information encoding unit 1046 also generates PAT (Program Association Table) and PMT

(Program Map Table). These types of control information

are supplied to the multiplexing unit 1047. Format of

the MPEG2-TS outputted from the multiplexing unit 1047

is as shown in Fig. 5.

5   [0020]

As shown in Fig. 5, it is defined that the MPEG2-TS

is multiplexed and separated by a fixed length transport

packet of 188 bytes. Each transport packet comprises

headers from synchronization byte to adaptation field

10   and a payload, which is actual information of image data

and audio data. In addition to the synchronization byte

and adaptation field, the header comprises PID (Packet

ID), scramble control information, adaptation field

control information, etc. The adaptation field control

15   information has 2 bits showing whether the adaptation

field is present or not and whether the payload is

present or not. Although not shown here, the payload

comprises PTS.

Information relating to PCR and stuffing byte

20   (invalid data byte) can be optionally included in the

adaptation field. The adaptation field comprises an

adaptation field length field, a discontinuous display

field, an optional field, etc. The optional field

comprises PCR, original PCR (OPCR), and private data.

25   [0021]

In the present embodiment, the private data is defined as given below to identify whether the jointed image-taking is present or not. More concretely, the private data is defined as follows: 32-bit ID string information PD1, 1-bit seamless reproducing point information PD2, 1-bit 2-3 pulldown information PD3, 1-bit pulldown repeat information PD4, 5-bit hold information PD5, and 5 PC data PD6, each comprising 8-bit PC0 to PC4.

The ID string information is information that the private data has a structure as defined in the above. The 2-3 pulldown information is information to indicate that an image signal of 24P (progressive with 24 frames) is converted to 60P (progressive with 60 frames) by 2-3 pulldown. The pulldown repeat information is information to indicate as to by which kind of pattern the 2-3 pulldown is repeated. PC data comprising PC0 to PC4 is additional information such as date information in DV format, time code, discriminant flag such as SD/HD. By defining additional information in DV format as PC data, the recording apparatus 100 can record the same information as additional information of DV format even when recording and reproduction are performed by MPEG2 method.

[0022]

In the present embodiment, "1" is generated during continuous image-taking as seamless reproducing point information, and "0" is generated in the other cases, e.g. when the jointed image-taking is performed. As already described, the jointed image-taking information generating unit 10462 converts the seamless reproducing point information from "1" to "0" in response to a control signal to indicate the instruction of the jointed image taking from the system control unit 111 and generates the jointed image-taking information packet. As a part of PID of the transport packet, a predetermined value is set to PID of the jointed image-taking information packet (i.e. a packet including PD1 to PD6).

[0023]

In the meantime, when the MPEG2-TS including the image encoding data sorted in groups to GOP, which comprises a plurality of pictures, is outputted, the MPEG encoder 104 (multiplexing unit 1047) outputs the jointed image-taking information packet within a predetermined time period from the time when the packet has been outputted including the leading byte of GOP. This predetermined time period is preferably 3 milliseconds. That is, the time interval between output time of the packet including the leading byte of GOP and

the output time of the jointed image-taking information packet is set to within 3 milliseconds.

[0024]

The MPEG2-TS as described above is recorded in the recording medium 107 as shown in Fig. 6. In Fig. 6, tracks up to the track T1 belong to one GOP, and a new GOP begins from the track t2. The GOP up to the track T1 corresponds to the recording Rc1 in Fig. 3, and the GOP from the track T2 corresponds to the recording Rc2 in Fig. 3. As shown in Fig. 6; a portion from a terminal end of the track T1, which is the final track of GOP, to a starting end of the track T2, which is the first track of GOP), is indicated as a null packet Pnull. Here, it is defined as a null packet Pnull, while it may include an audio packet in addition to the null packet. GOP in the track T2 is initiated from the leading Gtop.

As shown in Fig. 6, PCR is recorded at a plurality of points within one GOP, and PTS is recorded at the top of one GOP. PCR in the track T1 shown in Fig. 6 is discontinuous to PCR in the track T3.

[0025]

As described above, the MPEG encoder 104 outputs the jointed image-taking information packet within a predetermined time period from the time when the packet including the leading byte of GOP has been outputted.

Thus, the seamless reproducing point information PD2 is recorded near the leading Gtop of the GOP taken by the jointed image-taking. To facilitate the explanation, the seamless reproducing point information PD2 is described

5   as having a predetermined area in Fig. 6. However, generation time of the stream from the MPEG encoder 104 does not necessarily concur with recording time to the recording medium 107. Thus, the jointed image-making information packet is not always recorded within a

10 predetermined time period from the leading Gtop of GOP.

When the image signal is recorded in NTSC mode with 525 scan lines and 60 fields in DV format, 1 frame comprises 10 tracks. When recording is performed in the MPEG2 mode, the number of tracks in one frame is

15 variable.

[0026]

Turning back to Fig. 1, description will be given now on the reproduction of the recording medium 107. When the user presses a reproduction button 1105 in the

20 operation unit 110 shown in Fig. 1, a reproduction signal reproduced by the recording medium 107 is amplified by a reproduction amplifier 108 and is inputted to a reproduction signal processing circuit 109. The reproduction signal is shaped to an encoding data by

25 the reproduction signal processing circuit 109, and this

is supplied to the system control unit 111 and to a switching device 122. Based on the inputted data, the system control unit 111 identifies whether the reproduction signal is a signal of DV mode or a signal

5   of MPEG2 mode. Depending on the identified result, the system control unit 111 performs the switching by the switching devices 122 and 123.

If the reproduction signal is a signal of DV mode, the switching device 122 supplies the DV encoding data

10   from the reproduction signal processing circuit 109 to the DV decoder 113. If the reproduction signal is a signal of MPEG2 mode, the MPEG2 encoding data from the reproduction signal processing circuit 109 is supplied to the MPEG decoder 114.

15   [0027]

The DV decoder 113 decodes the inputted DV encoding data and supplies it to the switching device 123. The MPEG decoder 114 decodes the inputted MPEG2 encoding data and supplies it to a down converter 115 and to an

20   HD signal output terminal 134. The down converter 115 converts HD signal to SD signal and supplies it to the switching device 123. Under the control of the system control unit 111, the switching device 123 sends either an image signal outputted from the DV decoder 113 or an

25   image signal outputted from the down converter 115 to

the SD signal output terminal 133. The image signal of

SD signal is outputted from the SD signal output

terminal 133, and the image signal of HD signal is

outputted from the HD signal output terminal 134.

5   [0028]

Next, description will be given on an arrangement

example of the MPEG decoder 114 shown in Fig. 1

referring to Fig. 7. In Fig. 7, processing of an audio

(voice) signal not shown in Fig. 1 is given. In Fig. 7,

10   the MPEG2 encoding data, which is also a

reproduction/transmission data, is inputted to a header

decoding unit 1141, and the header of the MPEG2-TS as

explained in connection with Fig. 5 is decoded. Based on

the result of the decoding of the header at the header

15   decoding unit 1141, a video packet included in the

payload of the MPEG2-TS is sent to an image decoding

unit 1142. An audio packet is sent to an audio decoding

unit 1143. Various types of control information

including PCR, jointed image-taking information packet,

20   PAT and PMT are sent to an information decoding unit

1144.

Based on the control by the system control unit 111,

the image decoding unit 1142 decodes the video packet

and outputs PTS. Based on the control by the system

25   control unit 111, the audio decoding unit 1143 decodes

the audio packet.

[0029]

The information decoding unit 1144 comprises a PCR reading unit 11441 and a jointed image-taking

5 information reading unit 11442. The PCR reading unit 11441 extracts PCR included in the above control information and sends it to PCRPLL (PCR Phase Locked Loop) circuit 1145. Based on the inputted PCR, the PCRPLL circuit 1145 generates a clock (STC) of 27 MHz

10 and sends it to an STC counter 1146. In normal state as to be described later, the STC counter 1146 generates an STC counter value according to the clock of 27 MHz as inputted and sends it to a display timing signal generating unit 1147.

15 The jointed image-taking information reading unit 11442 extracts the jointed image-taking information packet included in the above control information and sends a signal "1" or "0" of the seamless reproducing point information PD2 to the PCRPLL circuit 1145 and to

20 the display timing signal generating unit 1147. PTS outputted from the image decoding unit 1142 is also inputted to the display timing signal generating unit 1147.

[0030]

25 The STC counter 1146 and the display timing signal

generating unit 1147 are in the case where the seamless

reproducing point information PD2 is "1", i.e. the case

where a recording signal recorded from continuous image-

taking is reproduced. It is in normal state where

5   continuous PCR is reproduced and the case where the

seamless reproducing point information PD2 is "0", i.e.

the case where the recording signal recorded by the

jointed image-taking is reproduced. Thus, operation is

different from non-normal state where discontinuous PCR

10 is reproduced.

First, in normal state, based on STC inputted from

the PCRPLL circuit 1145, the STC counter 1146 generates

an STC counter value. The display timing signal

generating unit 1147 generates a display timing signal

15 when PTS sent from the image decoding unit 1142 concurs

with the STC counter value sent from the STC counter

1146.

[0031]

Next, in non-normal state, the PCRPLL circuit 1145

20 neglects the PCR inputted from the PCR reading unit

11441 and generates a free-run STC. The display timing

signal generating unit 1147 generates a display timing

signal with a predetermined fixed interval regardless of

whether PTS concurs with the STC counter value or not.

25 The predetermined fixed interval is a frame frequency of

HD signal, i.e. a time interval of 30 Hz or 60 Hz.

[0032]

The image data outputted from the image decoding

unit 1142 and an audio data outputted from the audio

5   decoding unit 1143 are written in a buffer 1149 for once.

A reading control unit 1148 controls in such manner that

the image data stored in the buffer 1149 is read when

the display timing signal is inputted from the display

timing signal generating unit 1147. Although it is not

10   described in detail here, the audio data is read from

the buffer 1149 when the output timing signal generated

according to PTS for audio data has been inputted to the

reading control unit 1148.

[0033]

15   When a predetermined time has elapsed after the

seamless reproducing point information PD2 is changed

from "0" to "1", the PCRPLL circuit 1145 generates a

stable clock of 27 MHz according to a new PCR after the

jointed image-taking. Then, the STC counter 1146 and the

20   display timing signal generating unit 1147 return to

operation in the normal state.

[0034]

As described above, when PCR is turned to

discontinuous, the PCRPLL circuit 1145 neglects PCR

25   inputted from the PCR reading unit 11441 and generates a

free-run STC, and the display timing signal generating

unit 1147 generates a display timing signal with a

predetermined fixed interval. Thus, the freezing of the

image does not occur after the jointed image-taking, and

5   it is possible to display the image signal without

trouble before and after the jointed image-taking.

[0035]

Next, description will be given on the operation of

an IEEE1394 interface 112 and the output of a digital

10   image data and an audio data (hereinafter referred as

digital AV data) referring to Fig. 8 and Fig. 9.

[0036]

As shown in Fig. 8, based on the control by the

system control unit 111, a switch SW1 switches over the

15   reproduction signal processing circuit 109 and an

encoder output signal from the DV encoder 103 or the

MPEG encoder 104. In Fig. 1, the switch SW1 is not shown.

Either the output of the reproduction signal processing

circuit 109 or the encoder output signal is supplied to

20   the IEEE1394 interface 112 and to the DV decoder 113 or

to the MPEG decoder 114.

[0037]

The IEEE1394 interface 112 comprises a DV

processing unit 1121, an MPEG processing unit 1122, a

25   fixed pattern generator 1123, a 1394LINK 1124, a 1394PHY

1125 and switches SW2 and SW3. To transfer the digital

AV data, which is a DV encoding data, the DV processing

unit 1121 adds additional information such as CIP

(Common Isochronous Packet) header and the like and

5 performs division mapping to divide to packets suitable

for transfer. Similarly, the MPEG processing unit 1122

adds additional information such as CIP header in order

to transfer the digital AV data, i.e. MPEG2 encoding

data, and performs division mapping to divide to packets

10 suitable for transfer.

The operation unit 110 comprises an output mode

selecting button 1102. By the output mode selecting

button 1102, it is possible to switch over to DV

selection, MPEG selection or automatic selection. When

15 transfer mode for output switching is different between

the digital AV data to be recorded or reproduced and the

output switching by the output mode selecting button

1102, a fixed dummy data is generated by fixed pattern

generator 1123, and this is added to the digital AV data.

20 The 1394LINK 1124 is a link layer where the type of

the packets to be transferred on IEEE1394 bus and the

method of error checking are defined. The 1394PHY 1125

is a physical layer where encoding system of serial

signal, electrical specification of bus, and mediating

25 procedure when bus is used are determined. The switch

SW2 switches over and issues the output of the DV

processing unit 1121 and the output of the MPEG

processing unit 1122. The switch SW3 switches over and

issues the output of the switch SW2 and the output of a

5 fixed pattern generator 1123.

[0038]

When the DV encoding data is transferred via the

IEEE1394 interface 112, an AV/C protocol is used. The

AV/C protocol defines data structure when AV data is

10 sent by isochronous transfer via the IEEE1394 interface.

CIP header and real time AV data are stored in data

field of isochronous packet, and isochronous transfer is

carried out.

In DV standards, image data or audio data is

15 transferred as data block of 80 bytes called "DIF block",

and 6 DIF blocks (480 bytes) are transferred in one

isochronous packet. Data for one track of DV digital

video is transferred as a total of 150 DIF blocks

including one header block, 135 video data blocks, 9

20 audio blocks, 3 video AUX data blocks, and 2 sub-code

data blocks. Namely, it corresponds to 25 packets of

isochronous transfer. In case of NTSC, one video frame

comprises 10 tracks. Thus, video data of one frame

comprises 250 isochronous packets, and 30 frames of

25 video data comprise 7500 isochronous packets. In the

isochronous transfer, 1 cycle consists of 125 μs.
Because there are 8000 cycles in one second, the DV mode
data can be transferred at real time.

[0039]

5   On the other hand, when the MPEG2 encoding data
(MPEG2-TS) is transferred via the IEEE1394 interface 112,
the AV/C protocol is used similarly for the transfer of
DV mode data. In MPEG, it is defined that data type to
transmit or receive the encoded data stream comprises a
10   transport packet of 188 bytes. By this packet, image
data and audio data are multiplexed.

As already described, MPEG2-TS comprises PCR, and
PCR is generated from a system clock of 27 MHz used in
the encoder. On the receiving side to receive the MPEG2-
15   TS, the counter value of the system clock on the
receiving side is corrected according to PCR. If
variation occurs in delay time when the data is received,
the system clock on the receiving side may change and
this may cause trouble on display. In this respect, when
20   a packet of the MPEG2-TS (MPEG transport packet) is
transferred via the IEEE1394 interface 112,
consideration must be given on the maximum delay time
during the transmission, and transmission is performed
by adding 4-bytes time stamp on the transmitting side.
25   On the receiving side, based on the added time stamp,

the timing of decoding of the MPEG transport packet is managed according to the added time stamp, and variation of the delay time is corrected.

[0040]

5   In the isochronous transfer via the IEEE1394 interface, the size of the data to be transmitted in one cycle is fixed for the purpose of keeping the data transfer speed. Thus, to transfer the MPEG transport packet at optimal transfer speed, the time stamp of 4

10   bytes as described above is added to the MPEG transport packet of 188 bytes. The packet of 192 bytes thus added is split into 24-bytes units and are transferred. When a 24-bytes packet is transferred in one cycle via isochronous transfer, the transfer speed is 1.536 Mbps

15   (24 bytes × 8000 cycles × 8 bits). This is an optimal minimal byte unit to transfer the MPEG data with an encoding speed of 1.5 Mbps or more.

[0041]

Referring to Fig. 9, description will be given now

20   on a case of animation transfer by MPEG2 with an encoding speed of 4 Mbps. As shown in Fig. 9, the number of data blocks included in the payload of one isochronous packet is set to four using the packet divided to 24 bytes as a unit. As a result, the transfer

25   speed is maintained at 6.144 Mbps. Before the data block

transferred in one isochronous packet, CIP header

information as defined in AV/C protocol is added. In

this header information, the type of data, number of

divisions of transport packet, data block number, size

5   of data block, etc. are stored. In case there is no data

block to be sent depending on the condition of the image

to be encoded, a dummy packet added only with CIP header

is transmitted.

[0042]

10   Upon receipt of this isochronous packet via the

IEEE1394 interface, the external decoder neglects PCR

before the jointed image-taking information packet on

the stream and decodes the stream according to a display

timing signal with a predetermined time interval. As a

15   result, even when the user stops and resumes the image-

taking, i.e. if the user performs the so-called jointed

image-taking, the freezing of the image does not occur

after the jointed image-taking, and it is possible to

display the image signal without trouble before and

20   after the jointed image-taking.

INDUSTRIAL APPLICABILITY

[0043]

According to the present invention, when a

25   transport stream with discontinuous time information is

recorded and reproduced or when a transport stream with discontinuous time information is inputted from an external device (external encoding apparatus) via an interface such as the IEEE1394 interface and is

5   reproduced, no freezing of image occurs on a portion where the time information is discontinuous, and the image signal can be displayed without trouble and difficulty before and after the portion where the time information is discontinuous.

10   Also, when the transport stream with discontinuous time information is sent to an external device (external decoding apparatus) via an interface such as the IEEE1394 interface and is reproduced by the external device, no freezing of image occurs on a portion where

15   the time information is discontinuous, and the image signal can be displayed without trouble and difficulty before and after the portion where the time information is discontinuous.